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**APPLICATION  
FOR  
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LETTERS PATENT**

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**FOR:                PIPING CONNECTOR AND METHOD OF  
FABRICATING THE SAME**

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# PIPING CONNECTOR AND METHOD OF FABRICATING THE SAME

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

5           The present invention relates to a piping connector preferably used in a fluid pipe in, for example, a cooling system or an intake system of an engine of an automobile.

### 2. Description of the Related Art

10           In connecting to, for example, a radiator hose or the like of an automobile, there is widely utilized a piping connector ( pipe joint ) made to be connected in one touch motion by only inserting a plug attached to an end portion of other pipe into a socket attached to an end portion of one pipe.

15           For example, in JP-A-10-9470, there is disclosed such a piping connector in which an outer peripheral groove is provided at an outer periphery of a female pipe ( socket ), the outer peripheral groove is provided with notched grooves penetrating inner and outer diameters and opposed  
20 to each other by a necessary angle, a stop piece arm ( stopper ) is engaged with a valley peripheral diameter portion of an unnotched groove portion, respective locking arms extended from the stop piece arm are made to span the respective notched grooves to lock, and portions of  
25 the respective locking arms are projected into the female

pipe and fit to a groove at an outer periphery of a male pipe ( plug ).

Such a piping connector is arranged with a seal ring between an inner periphery of the socket and an outer  
5 periphery of the plug in order to seal in airtight such that a fluid flowing at inside of a pipe does not leak in a state of connecting the connector.

The seal ring is mounted to a ring-like groove portion constituted by a ring-like stepped portion provided on  
10 a depth side of the socket and a hold ring provided on a side of an opening portion at a predetermined interval from the stepped portion. The hold ring is fixedly attached to the inner periphery of the socket by a method of fitting, press-fit or the like.

15 However, according to the method of fixedly attaching the hold ring to the inner periphery of the socket by fitting or press-fit, when a fluid at high temperature and high pressure is made to flow to inside of the connected pipe, there is a concern that the hold  
20 ring is detached by loosening fitting or press-fit.

Further, although it is also considerable to weld the hold ring to the inner periphery of the socket, particularly in the case of ultrasonic welding, a molten resin is extruded from a weld face to produce burrs and  
25 therefore, there is a concern that the burrs are brought

into contact with the seal ring to damage the seal ring.

#### SUMMARY OF THE INVENTION

It is an object of the invention to provide a piping  
5 connector made to be able to fixedly attach solidly to  
an inner periphery of a socket without damaging a seal  
ring and a method of fabricating the same.

In order to achieve the above-described object, a  
first of the invention provides a piping connector  
10 characterized in including a socket substantially in a  
tubular shape attached to an end of one pipe to be connected,  
a plug substantially in a tubular shape attached to an  
end of other pipe, a seal ring arranged at an inner  
periphery of the socket for sealing an interval between  
15 the inner periphery of the socket and an outer periphery  
of the plug in airtight, and a hold ring fixedly attached  
to the inner periphery of the socket for restricting the  
seal ring from moving in an axial direction, in which  
the pair of pipes are connected by inserting the plug  
20 to fit to the socket, wherein the hold ring includes a  
groove in a ring-like shape for constituting a burr storing  
space at an outer periphery thereof and is welded to the  
inner periphery of the socket by ultrasonic welding.

According to the invention, the groove in the  
25 ring-like shape for constituting the burr storing space

is formed at the outer periphery of the hold ring and therefore, burrs produced when the hold ring is subjected ultrasonic welding are stored at inside of the groove in the ring-like shape and prevented from flowing out to an outer portion and therefore, it can be prevented that burrs flowing out to the side of the seal ring to damage the seal ring and the hold ring can fixedly be attached solidly to the inner periphery of the socket by welding.

10           A second of the invention provides the piping connector, wherein in the ultrasonic welding, a portion of the hold ring pressed to the inner periphery of the socket is constituted by a corner portion faced in a curved shape having a radius of curvature of 0.2 through 0.5mm in the first invention.

          According to the invention, the portion of the hold ring pressed to the inner periphery of the socket in ultrasonic welding is constituted by the corner portion faced to the shape of the curved face having the radius of curvature of 0.2 through 0.5mm and therefore, the portion pressed to the inner periphery of the socket is not chipped, the seal ring can be prevented from being damaged by debris, the vibration energy is not dispersed and therefore, the welding can be carried out smoothly.

25           A third of the invention provides the piping

connector, wherein the inner periphery of the socket is provided with a first diameter contracted portion and a second diameter contracted portion from a side of an inserting port of the plug, the press ring is pressed  
5 to the first diameter contracted portion to weld and a stepped portion for constituting a stopper and a burr stopper in welding the hold ring is formed between the first diameter contracted portion and the second diameter contracted portion in the first or the second invention.

10 According to the invention, in subjecting the hold ring to ultrasonic welding, the hold ring is pressed to the first diameter contracted portion to weld, burrs produced there are stopped by the stepped portion between the first diameter contracted portion and the second  
15 diameter contracted portion and sealed at inside of the groove in the ring-like shape and therefore, the burrs can firmly be prevented from flowing out to a side of the seal ring. Further, the stepped portion also constitutes a stopper for stopping movement of the hold  
20 ring in ultrasonic welding of the hold ring to also contribute to positioning the hold ring.

A fourth of the invention provides a method of fabricating a piping connector characterized in a method of fabricating a piping connector including a socket  
25 substantially in a tubular shape attached to an end of

one pipe to be connected, a plug substantially in a tubular shape attached to an end of other pipe, a seal ring arranged at an inner periphery of the socket for sealing an interval between the inner periphery of the socket and an outer periphery of the plug in airtight, and a hold ring fixedly attached to the inner periphery of the socket for restricting the seal ring from moving in an axial direction, in which the pair of pipes are connected by inserting the plug to fit to the socket, wherein the inner periphery of the socket is provided with a first diameter contracted portion and a second diameter contracted portion from a side of an inserting port of the plug, the hold ring is welded to the first diameter contracted portion by applying an ultrasonic wave to the hold ring while being pressed to the first diameter contracted portion, the ultrasonic wave is stopped from being applied before the hold ring is brought into contact with a stepped portion formed between the first diameter contracted portion and the second diameter contracted portion and thereafter, the hold ring is pressed further to be brought into contact with the stepped portion.

According to the invention, by applying the ultrasonic wave to the hold ring while pressing the hold ring to the first diameter contracted portion, the hold ring is welded to the first diameter contracted portion.

Further, although the hold ring is moved in the pressing direction while being welded to the first diameter contracted portion, by stopping to apply the ultrasonic wave before the hold ring is brought into contact with the stepped portion formed between the first diameter contracted portion and the second diameter contracted portion, welding is carried out at the stepped portion to thereby prevent burrs from being produced. Further, burrs produced from the welded portion of the hold ring and the first diameter contracted portion are stopped by the stepped portion and sealed to inside of the groove in the ring-like shape and therefore, the burrs can firmly be prevented from flowing out to a side of the seal ring and the hold ring can fixedly be attached solidly to the inner periphery of the socket without damaging the seal ring.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figs.1A to 1C illustrate explanatory views showing a step of welding a hold ring according to an embodiment of a piping connector of the invention.

Figs.2A and 2B illustrate perspective views of the connector, Fig.2A is a disassembled perspective view and Fig.2B is a perspective view showing a connected state.

Figs.3A and 3B show the connected state of the



connector, Fig.3A is a side view and Fig.3B is a side sectional view.

Figs.4A and 4B show a socket of the connector, Fig.4A is a sectional view and Fig.4B is a view partially enlarging  
5 a hold ring.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figs.1A through 4B shows an embodiment of a piping connector according to the invention. Figs.1A to 1C are  
10 explanatory views showing a step of welding a hold ring of the connector, Figs.2A and 2B illustrate perspective views of the connector, Fig.2A is a disassembled perspective view, Fig.2B is a perspective view showing a connected state, Figs.3A and 3B illustrate a state of  
15 connecting the connector, Fig.3A is a side view, Fig.3B is a side sectional view, Figs.4A and 4B illustrate a socket of the connector, Fig.4A is a sectional view, and Fig.4B is a view partially enlarging a hold ring.

As shown by Figs.2A and 2B, the connector 10 is  
20 constituted by a plug 20 substantially in a tubular shape attached to an end portion of one pipe to be connected, a socket 40 substantially in a tubular shape attached to an end portion of other pipe, and a stopper 60 mounted to the socket 40 and formed by a bent wire.

25 The plug 20 constitutes a structure constituting

a shape formed by making a first taper portion 22, a straight portion 23, and a second taper portion 24 continuous from a front end side thereof in a direction of being inserted into the socket 40 and formed with a ring-like groove portion 25 and a positioning projection 26 at an outer periphery of a ridge portion of the second taper portion 24.

Meanwhile, the socket 40 is provided with an attaching port 41 connected with other pipe to be connected, not illustrated, for example, a hose, a tube or the like at one end thereof and is provided with an inserting port 43 for receiving the plug 20 at other end thereof. The attaching port 41 is formed to bend by an angle of about 60 degrees relative to a socket main body portion to extend. A front end portion of the attaching port 41 is formed with a rib 42 in a ring-like shape to enhance an effect of preventing the pipe to be connected from being drawn.

The main body portion of the socket 40 constitutes a cylindrical shape in a size and in a shape for receiving the plug 20. Also in reference to Figs. 3A to 4B, the main body portion of the socket 40 constitutes a shape for expanding a diameter thereof in steps and is provided with a first diameter expanded portion 44 having an inner diameter slightly expanded from the portion of being connected to the attaching port 41, a second diameter

expanded portion 45 an inner diameter of which is slightly  
expanded from the first diameter expanded portion 44 and  
a third diameter expanded portion 46 a diameter of which  
is further expanded from the second diameter expanded  
5 portion 45.

Further, the first diameter expanded portion 44 of  
the socket 40 constitutes an inner diameter for inserting  
the first taper portion 22 and the straight portion 23.  
Further, a seal ring 50 arranged at the second diameter  
10 expanded portion 45 of the socket 40 is constituted by  
an inner diameter for being brought into close contact  
with the straight portion 23 of the plug 20. Further,  
the third diameter expanded portion 46 of the socket 40  
is constituted by an inner diameter capable of containing  
15 the second taper portion 24, the ring-like groove 25 and  
the positioning projection 26 and the like of the plug  
20.

Particularly as shown by Fig. 3B, Fig. 4A, at an inner  
periphery of the socket 40, a stepped portion 47 is formed  
20 between the first diameter expanded portion 44 and the  
second diameter expanded portion 45 and a hold ring 49  
is mounted between the second diameter expanded portion  
45 and the third diameter expanded portion 46.

Further, the seal ring 50 is installed at a groove  
25 in a ring-like shape formed between the stepped portion

47 and the hold ring 49. That is, the seal ring 50 is held at a predetermined position by the stepped portion 47 and the hold ring 49.

In reference to Figs.1A to 1C again, the third  
5 diameter expanded portion 46 of the socket 40 is formed with a guide groove 51 for inserting the positioning projection 26 of the plug 20 and an outer periphery of the guide groove 51 constitutes a wall portion 52 which is bulged partially. The positioning projection 26 of  
10 the plug 20 is inserted into the guide groove 51 of the socket 40 to thereby restrict an angle of integrating the plug 20 and the socket 40.

The third diameter expanded portion 46 is formed with a notched groove 53 for inserting the stopper 60.  
15 The notched groove 53 is formed in a slit-like shape to penetrate inside and outside of the socket 40 along portions opposed to each other in a peripheral direction of the third diameter expanded portion 46.

An upper half portion of the notched groove 53 at  
20 the outer periphery of the third diameter expanded portion 46 is formed with a pair of ribs 54 projected from edge portions of the notched groove 53 opposed to each other and the ribs 54 pinches the stopper 60 to firmly hold. Further, a middle portion of the notched groove 53 at  
25 the outer periphery of the third diameter expanded portion

46 is formed with a recess portion 55 having a section in a V-like shape along the peripheral direction. Further, a lower end of the notched groove 53 at the outer periphery of the third diameter expanded portion 46 is formed with  
5 a containing recess portion 56 formed by a wall in a channel-like shape for containing an end portion of the stopper 60.

The stopper 60 is constituted by a wire or the like bent in a gate-like shape as a whole. A center portion  
10 of the stopper 60 is formed with an outwardly bent portion 61 matched to the outer periphery of the bulged wall portion 52. Both end portions of the stopper 60 are formed with forwardly bent portions 62 bent by substantially  $90^\circ$  to a side of the inserting port 43. Further, a portion of  
15 the stopper 60 slightly proximate to the base portion from the forwardly bent portion 62 is formed with an inwardly bent portion 63 bent to an inner side in a shape of a circular arc.

In mounting the stopper 60 to the socket 40, first,  
20 the stopper 60 is covered thereon from an upper side while widening the both end portions of the stopper 60 and while inserting the stopper 60 into the notched grooves 53 of the socket 40. Then, the forwardly bent portion 62 of the stopper 60 is fit to the recess portion 55 in the  
25 V-like shape at the outer periphery of the socket 40 and

is tackedly held thereby. When the stopper 60 is further pressed strongly to a lower side under the state, the both end portions of the stopper 60 are slid while being widened further and the forwardly bent portions 62 are  
5 fit to the containing recess portions 56.

At this occasion, the both end portions of the stopper 60 are inserted into the notched grooves 53 of the socket 40, portions thereof are brought into a state of being projected from the inner periphery of the notched groove  
10 53 to the inner side, particularly, the inwardly bent portions 63 are considerably projected to the inner side. At this occasion, each of the end portions of the stopper 60 traverses a circumference of the notched groove 53 as in a chord and is intersected with the notched groove  
15 53 at two upper and lower portions thereof and the inwardly bent portion 63 is formed at a lower side intersected portion thereof.

Therefore, in connecting the piping connector 10, when the plug 20 is inserted into the socket 40 while  
20 inserting the positioning projection 26 of the plug 20 into the guide groove 51 of the socket 40, first, the first taper portion 22 of the plug 20 is brought into contact with inside of the seal ring 50 arranged at inside of the socket 40 and the plug 20 is pressed thereto while  
25 pressing the seal ring 50 to the inner wall of the socket

40. Next, the stopper 60 is brought into contact with the second taper portion 24 to rise on the second taper portion 24 while being pressed to widen. Further, after the stopper 60 has finished to rise on the second taper  
5 portion 24, the stopper 60 is dropped to fit to the groove 25 of the plug 20 to thereby finish to connect the plug 20 and the socket 40.

Although the piping connector 10 is provided with a basic structure as described above, a characterized  
10 portion of the invention resides in a structure of fixedly attaching the hold ring 49 to the inner periphery of the socket 40, that is, a structure of fixedly fixing the hold ring 49 to the inner periphery of the socket 40 by ultrasonic welding explained below.

15 That is, as shown by Figs. 1A to 1C, between the second diameter expanded portion 45 and the third diameter expanded portion 46 of the inner periphery of the socket 40, in view from a side of the inserting port 43, there are formed a first diameter contracted portion 71 a  
20 diameter of which is contracted from an inner periphery 70 of the third diameter expanded portion 46, and a second diameter contracted portion 72 a diameter of which is further contracted from the first diameter contracted portion 71. A first stepped portion 73 including a taper  
25 in a linear shape is provided between an inner periphery



70 of the third diameter expanded portion 46 and the first  
diameter contracted portion 71, and a second stepped  
portion 74 in a wall-like shape rising at right angle  
is formed between the first diameter contracted portion  
5 71 and the second diameter contracted portion 72.

Further, also in reference to Fig.4B, the hold ring  
49 mounted to the inner periphery of the socket 40 is  
constituted by a large diameter portion 80 having an outer  
diameter substantially matched to the inner periphery  
10 40 of the third diameter expanded portion 46, a groove  
81 in a ring-like shape having a section in a V-like shape  
formed at an outer periphery of the large diameter portion  
80, a small diameter portion 82 formed at an end portion  
of the ring-like groove 81, an end face 83 on a side of  
15 the small diameter portion 82, a rib 84 formed at an inner  
periphery in correspondence with the small diameter  
portion 82, an inner peripheral wall 85 formed on an inner  
peripheral side of the large diameter portion 80  
contiguously to the rib 84, and an end face 86 on a side  
20 of the large diameter portion 80. The small diameter  
portion 82 constitutes an outer diameter matched to the  
inner periphery of the first diameter contracted portion  
71.

Further, the groove 81 in the ring-like shape is  
25 provided with a wall portion 81a rapidly falling from



the large diameter portion 80 to the inner peripheral side, and a wall portion 81c rising in a taper shape from a bottom portion 81b to the small diameter portion 82, and a corner portion 87 a section of which is faced in a shape of a circular arc is formed between the wall portion 81a and the outer periphery of the large diameter portion 80. The corner portion 87 constitutes a welded portion by being brought into contact with the first stepped portion 73 of the socket 40 in ultrasonic welding, mentioned later.

According to the invention, it is preferable that a radius of curvature  $R$  of the corner portion 87 for constituting the welded portion is made to be 0.2 through 0.5mm. When the radius of curvature  $R$  is less than 0.2mm, there is a concern of being chipped off in ultrasonic welding and when the radius of curvature  $R$  is larger than 0.5mm, vibration energy is dispersed and therefore, welding can not be carried out smoothly.

Figs.1A to 1C shows a step of fixedly attaching the hold ring 49 to the inner periphery of the socket 40 by ultrasonic welding.

That is, as shown by Fig.1A, first, the hold ring 49 is inserted from a side of the inserting port 43 to the inner periphery of the socket 40, the small diameter portion 82 is brought into contact with the inner periphery

of the first diameter contracted portion 71 and the large diameter portion 80 is brought into a state being brought into contact with the inner periphery 70 of the third diameter expanded portion 46. Under the state, a horn 90 of an ultrasonic vibrator is brought into contact with the hold ring 49 to press the hold ring 49 as shown by an arrow mark in the drawing. Further, in Figs. 1A to 1C in a state of vibrating the horn 90, the state is indicated by hatchings in a mesh-like shape and in a state of stopping vibration, the state is indicated by dispensing with the hatchings.

As a result, as shown by Fig. 1B, the corner portion 87 of the hold ring vibrated by the horn 90 is pressed to the first stepped portion 73 and a contact portion between the corner portion 87 and the first stepped portion 73 is melted by friction heat to weld. At this occasion, although a molten resin extruded from the welded portion constitutes burrs to flow out, the burrs are stored in the groove 81 in the ring-like shape and therefore, the burrs do not flow out to a side of the second diameter contracted portion 72 for constituting a containing portion of the seal ring 50.

Further, when vibration of the horn 90 is stopped before the end face 83 on the side of the small diameter portion 82 is brought into contact with the second stepped

portion 74 and the hold ring 49 is further pressed by the horn 90, as shown by Fig.1C, the end face 83 is brought into contact with the second stepped portion 74 by crushing to weld pieces of the molten resin and movement of the hold ring 49 is stopped. Under the state, the hold ring 49 is welded to the inner periphery of the socket 40 and therefore, a position of fixedly attaching the hold ring 49 can accurately be determined.

Further, the burrs by the molten resin extruded from the welded portion are stored at inside of the ring-like groove 81, the end face 83 of the hold ring 49 is finally brought into contact with the second stepped portion 74 and therefore, the burrs are completely sealed by the second stepped portion 74 and can further completely prevented from flowing out to the second diameter contracted portion 72 for constituting the containing portion of the seal ring 50.

According to the connector 10 of the invention fabricated in this way, the hold ring 49 of the seal ring 50 is fixedly attached to the inner periphery of the socket 40 by ultrasonic welding and therefore, the hold ring 49 is not stripped off from the inner periphery of the socket 40 and airtightness can excellently be maintained over a long period of time by holding the seal ring 50 at a correct position.

As has been explained above, according to the invention, the groove in the ring-like shape for constituting a burr storing space is formed at the outer periphery of the hold ring and therefore, the burrs  
5 produced in subjecting the hold ring to ultrasonic welding are stored in the groove in the ring-like shape and prevented from flowing out to the outside portion and therefore, it can be prevented that the burrs flow out to the side receive ring to damage the seal ring and the  
10 hold ring can fixedly be attached solidly to the inner periphery of the socket.